Mycorrhizae : physiology and genetics - Les mycorhizes : physiologie et génétique.
I[st] ESM/I[er] SEM, Dijon, 1-5 July 1985.- INRA, Paris, 1986

Production of some organic substances by mycorrhizal fungi of pine (*Pinus sylvestris* L.)

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INTRODUCTION

It is known that metabolites of mycorrhizal fungi are of great importance for the plant and for the microorganisms living in the rhizosphere of mycorrhizae (HARLEY, 1948 ; KATZNELSON *et al.*, 1962 ; NEAL *et al.*, 1964 ; DAVEY, 1971 ; RAMBELLI, 1973 ; SLANKIS, 1973, 1974).

In this work studies were performed on production of free amino acids, B-group vitamins and plant growth regulators like auxins and cytokinin-like substances by the following ectomycorrhizal fungi of pine : *Amanita muscaria, Cenococcum geophilum, Paxillus involutus, Rhizopogon luteolus, Suillus bovinus, S. granulatus* and *S. luteus*.

Amino acids

The fungi studied produced most often glutamic acid, alanine, leucine, lysine, ornithine and arginine. Both the quality and quantity of amino acids released was different in the fungi studied. The amount of the predominating amino acid (alanine, arginine, lysine) in the post-culture liquid usually did not exceed 1.5 µg/mg dry mass. Amino acids are known to be of importance for bacteria occurring in the root zone.

Vitamins

It appears from Fig. 2 that none of the fungi studied produced biotin. Other vitamins were released in different amounts by all fungi studied (most of them - by *Suillus luteus* and least - by *Cenococcum geophilum*) Traces of nicotinic acid in post-culture liquids of *C. geophilum* were detected. All the organisms studied excreted thiamin in large amounts.

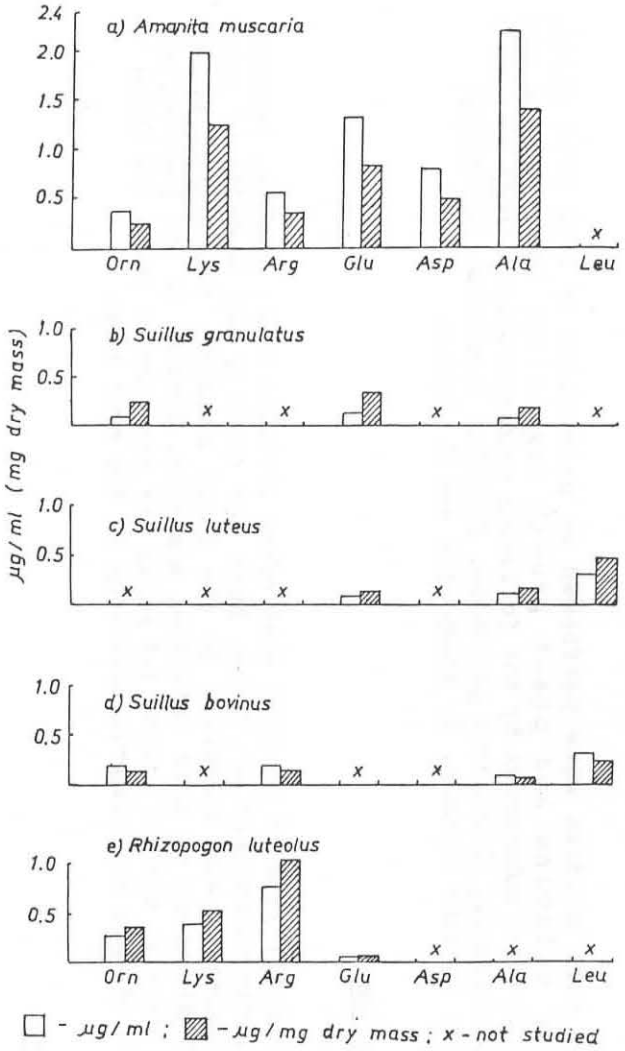

Figure 1. Amounts of amino acids produced by the mycorrhizal fungi.

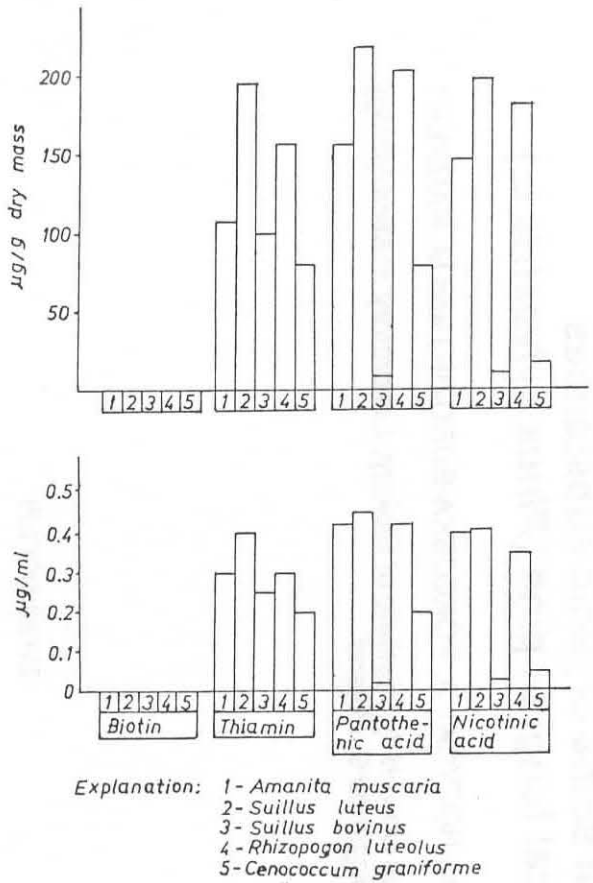

Figure 2. Amounts of vitamins synthesized by the mycorrhizal fungi

Plant growth regulators (auxins and cytokinin-like substances)

Table 1 shows that the ectomycorrhizal fungi studied did not synthesize auxins in media without tryptophan. Traces of auxins were found in three isolates. In the presence of this amino acid all the isolates produced auxins in amounts not exceeding 0.1 µg/ml medium. Exceptionally *R. luteolus* produced 0.16 µg E. IAA/ml and 80 µg E. IAA/g dry mass. On the basis of the Rf value, we assume that the organisms studied synthesized IAA and some of them, *P. involutus*, *S. luteus* and *R. luteolus* also produced other substance having auxin activity (probably 3-indolebutyric acid - IBA).

Table 1. Production of auxins by mycorrhizal fungi of pine (Pinus sylvestris L.)

Mycorrhizal fungi	Medium without tryptophan			Medium with tryptophan		
	Total amount of auxins expressed as IAA equivalents					
	µg/ml of medium	µg/g of dry mass	Rf	µg/ml of medium	µg/g of dry mass	Rf
Amanita muscaria	0	0	-	0.082	56.2	0.2-0.5
Suillus bovinus No.7	trace	-	0.3-0.4	0.085	33.1	0.3-0.5 0.7-0.8
Suillus luteus	0.008	8.9	0.2-0.3 0.7-0.8	0.040	75.8	0.2-0.4 0.6-0.8
Suillus bovinus No. 12	0.018	5.1	0.3-0.5	0.076	37.2	0.2-0.5
Rhizopogon luteolus	0	0	- -	0.159	78.5 78.5	0.2-0.4 0.5-0.7

Table 2 shows the cytokinin-like substances produced by the fungi studied. *R. luteolus* and *P. involutus* synthesized these substances in amounts of 0.51 - 4.96 g of kinetic equivalents/g dry mass.

The results obtained by gas chromatography have shown that *R. luteolus* produced 6-/ɣɣ-dimethylallylamino/purine and zeatin riboside. *P. involutus* produced a cytokinin-like substance which we suppose to be zeatin.

Table 2. Production of cytokinin- like substances by mycorrhizal fungi of pine (*Pinus sylvestris* L.)

Organisms	Amount of cytokinin- like substances/E. kin. - µg/g dry mass	Fraction No.
Amanita muscaria	0	0
Suillus bovinus No.7	0	0
Suillus bovinus No.12	0	0
Paxillus involutus	0.51	48-64
Rhizopogon luteolus	3.31	24-36
Suillus luteus	0	0

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